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Nexus Between Production Practices, Quality and Safety Attributes, and Consumer Preference in Mango Sector in Sri Lanka

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Abstract

The domestic market in Sri Lanka is the primary destination for locally produced mangoes. There is a notable economic transition within this market, characterized by an increased focus on healthy lifestyles and evolving preferences for fresh agro-food products, including mangoes. Understanding the variation of consumer preference is important for improving the value chain of mangoes in Sri Lanka. This study attempts to assess the relative importance of quality, safety, and health attributes on consumer preference for mangoes and investigate the relationship between demographics and these preferences. Moreover, it evaluates consumer behavior in the purchase of mangoes and identifies the causes of postharvest losses at the consumer level. In this study, six divisions in the Monaragala district

were selected targeting mango consumers of different age groups, education levels, and purchasing patterns. A structured questionnaire was used to collect information from 200 customers by conducting face to face interviews. Systematic sampling with simple random sampling techniques was done. The data were analyzed using IBM SPSS Statistics version 25 with descriptive statistics and non-parametric tests. The findings show that, although all internal and external quality attributes of mangoes are of concern to consumers, the health and safety attributes are those of the highest concern. This study provides valuable insights to the key stakeholders in the mango supply chain toward reduction of inefficiencies, enhancement of profitability, and consumer satisfaction.

Keywords: Mango, Quality Attributes, Consumer Preferences, Health and Safety, Post-Harvest Losses, Supply Chain

1. Introduction

1.1 Background of the Study

The mango (*Mangifera indica*), which is regarded as the "King of Fruits" in Asian countries, is praised for its delicate taste, pleasant aroma, and high nutritious content around the world (Singh *et al.* 2013). Mangoes are grown in over 85 countries with tropical and subtropical climates. The global cultivation area and the production output were over 3.69 million hectares and 35 million tons respectively in 2009 (FAO, 2009; Honja, 2014). The widespread cultivation and strong market demand for it contribute to its popularity, which has a substantial impact on agriculture and the economy. Fresh product is the primary market for mangoes in Sri Lanka. The fruit is more valuable economically because of its versatility, since it can be used to make products like juices and jams and consumed fresh. Mangoes, which are native to India, are also some of the most popular and frequently consumed fruits in Sri Lanka. Mango cultivation spans 29,965 hectares throughout the nation, with an estimated 530.56 million fruits produced in 2022 (Department of Census and Statistics, 2019).

Some important mango varieties grown in major mango producing districts in Sri Lanka, such as Kurunegala, Gampaha,

Ratnapura, Matale, Hambantota, Moneragala, Puttalam, and Matara include TomEJC (TJC), Betti, Kohu, Villard, and Karthacolomban (Wasala, 2020). Every variety has unique characteristics in terms of flavor, aroma, texture, and appearance. Mango farming and selling are important to the livelihoods of local farmers in Sri Lanka as well as the growth of the local economy.

However, poor quality fresh food poses serious problems for the industry, resulting in large postharvest losses. These losses, which vary globally from 25% - 45% at different postharvest stages (Alam *et al.*, 2019) and locally range from 20%-40% for vegetables and 30%-40% for fruits as well (Rajapaksha *et al.*, 2021). This negatively impacts both the nutritional status of the population and the economies of developing nations. In Sri Lanka, where mangoes are mainly grown in home gardens, production is scattered (Herath *et al.*, 2021). Fresh fruit and vegetable quality encompasses both consumer- and product-oriented factors (Shewfelt, 1999). Consumer-oriented quality is dependent on consumer acceptability and purchasing willingness, whereas product-oriented quality is based on measurable features (Kays, 1999). As consumer preferences drive the agribusiness sector, understanding these preferences are very important (Soosay *et al.*, 2012). The Agro-food sectors need to be aware of the value preferences of their customers and understand the characteristics of various customer segments. Developing nations particularly benefit from this kind of strategy (Macharia *et al.*, 2013).

In order to direct industry changes, this study investigates customer value preferences for mangoes in the Monaragala district of Sri Lanka. The growth and sustainability of the mango industry can be supported by stakeholders by improving product offers and market strategies that link value chain methods with customer preferences for quality, safety, and health qualities. The structure of this paper comprise description of the Sri Lankan mango industry, objectives of this study, a review of the literature on perceived quality and consumer preferences, a presentation of the conceptual framework, the details of the research methodology, the findings, and a discussion of the findings and their implications for the mango industry.

This study aims to give important information to those involved in the Sri Lankan mango industry. By understanding consumer preferences and purchasing behavior, producers, distributors, and retailers can implement strategies that ensure mangoes meet the highest quality and safety standards while effectively communicating the health benefits to consumers. In the end, this will result in lower post-harvest losses, higher customer satisfaction, and a more competitive mango market in Sri Lanka.

1.2 Objectives of the Study

The overall objective of the study is to understand the nexus between production practices, quality and safety attributes, and consumer preference in mango sector in Sri Lanka. To achieve the above overall objective, the study was conducted under four specific objectives.

1. To evaluate the relative importance of quality, safety, and health attributes in influencing consumer preferences for mangoes.
2. To investigate the relationship between demographics and consumer preferences for these attributes.

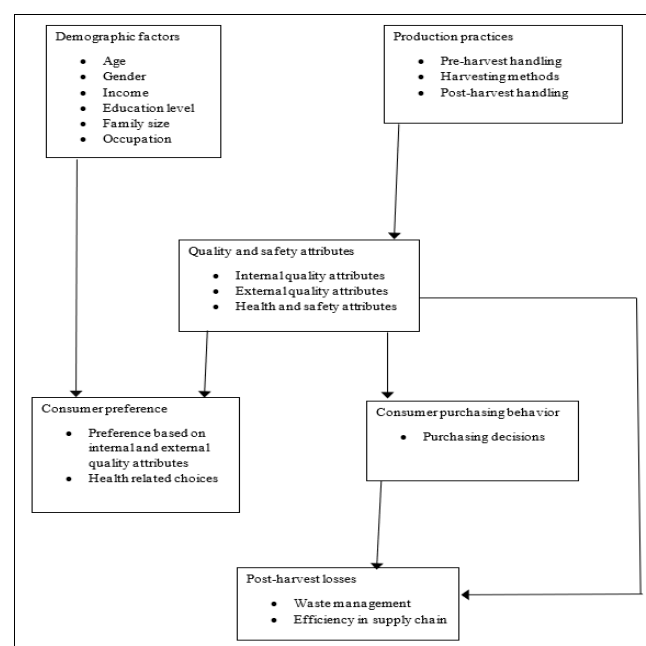
3. To assess consumer behavior in purchasing mangoes based on these attributes
4. To identify the cause of post-harvest losses of mangoes at the consumer level.

1.3 Expected Limitations

This study has several limitations that were found. The accuracy of the consumers preferences depended on the self-reported information from consumers, hence has bias. The field surveys were limited to one season and one district due to financial and logistical issues related to accessibility to certain places and availability of limited time. Therefore, seasonal and regional variations in mango production and quality may affect the generalizability of the results. Also, the ability of consumer preferences to change and the dynamism of the market trends may challenge the possibility of capturing a static picture of the mango sector. Furthermore, accurate responses were not always easy to obtain, and some respondents were refuse to give their personal information such as their age, occupation, and level of education. Of the 200 respondents, 4 cases had to be withdrawn from the analysis due to missing information.

1.4 Conceptual Framework

The conceptual framework of this study has been adopted and developed with insights and ideas drawn from several key publications including those by, Yaseen *et al.*, 2016 and Bolwig *et al.*, 2008. The conceptual framework that underlines this research establishes a relationship between the attributes of production practices and quality and safety with consumer preferences. The production practices, harvesting method, post-harvest handling, and storage conditions affect the quality and safety attributes related to freshness, texture, taste, and absence of defects present in mangoes. After that, these quality and safety attributes of mangoes influence consumer preferences and purchasing decisions. Demographic factors, such as age, income, and education, are moderating variables with regard to consumer behavior and preference. This framework is designed to understand the overall process of how production practices could link up better with consumer demand, enhancing competitiveness for the mango sector in Sri Lanka.



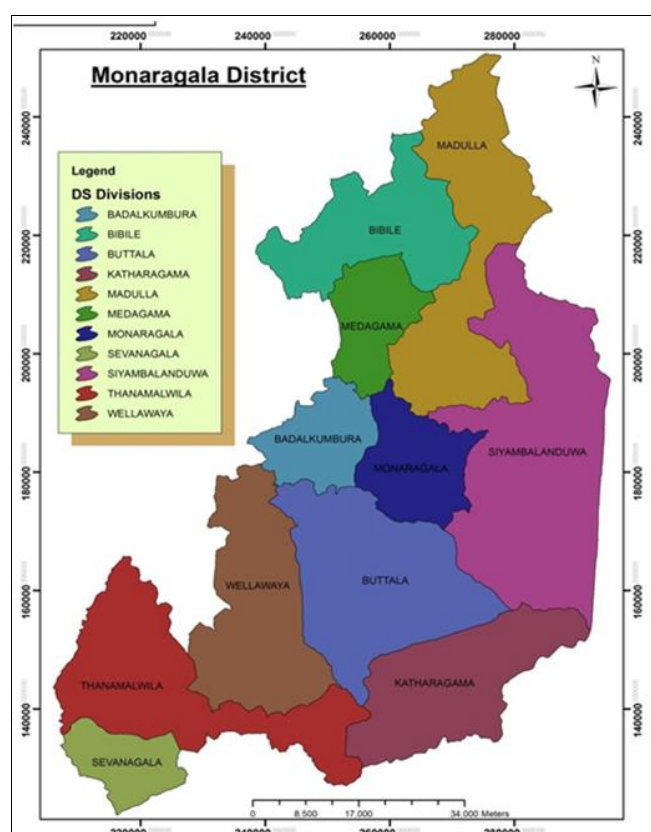
2. Research Methodology

2.1 Introduction

This chapter outlines the methodology used to accomplish the objectives of the study. The research population, sample size, sampling techniques, study design, data collection methods, and variables and measurements are covered in detail. It also describes the techniques for data analysis.

2.2 Description of the Study Area

The study was conducted in the Monaragala district, which has a total area of 5,636 km². Monaragala, which contributes a significant portion to the total mango production in Sri Lanka, plays a crucial role in the local economy and the dietary habits of its residents. According to the Department of Census and Statistics, In Monaragala, mango cultivation land extent is 2,772.1 hectares, while mango fruit production was 22,913 nuts in 2022. There are 11 divisional secretariats in the Monaragala district; six of these divisional secretariats, namely Monaragala, Wellawaya, Thanamalwila, Badalkumbura, Sewanagala, and Buttala, were selected purposively for this study. (Fig 3.1).



2.3 Target Population

The target population for this study consisted of mango consumers in the 6 divisional secretary's divisions in Monaragala district. People with different age ranges, educational backgrounds, and different purchasing habits were among the selection criteria. This diversity ensured a broad understanding of consumer preferences across different demographic segments.

2.4 Sample Size and Sampling Method

Probability sampling methods were used as the sample selection method. The questionnaire survey used as the primary method of data collection. One structured questionnaire was used as the main data gathering tool

(Appendix). A five-point Likert scale, ranging from "not important" (1) to "very important" (5), was used to evaluate the variables utilized to measure the research objectives. All of the components were measured using a multiple items of questions, and respondents were asked to provide replies based on their consumption and purchasing habits of mangos. For the survey, 200 customers in total were chosen by a combination of systematic and simple random sampling techniques. Detailed survey was elaborated to those consumers and made them to the right response and awareness. Four cases were eliminated due to missing values, resulting in a final dataset of 196 respondents. The sample was distributed as follows among the selected divisions: (Table 3.1).

Table 4.1: The tabular representation of the number of respondents from different shop types in each division

Division	Supermarket	Retail shop	Street vendors	Wholesale shop	Total
Monaragala	10	15	10	15	50
Wallawaya	6	6	8	10	30
Thanamalwila	0	13	7	10	30
Badalkumbura	7	7	7	9	30
Buttala	7	7	7	9	30
Sewanagala	0	14	6	10	30
Total	30	62	45	63	200

2.5 Data Collection Process

2.5.1 Primary Data Collection

Primary data were collected through face-to-face interviews using a pre-structured questionnaire. The respondents were selected systematically. Every fifth consumer at the chosen wholesale stores, retail stores, roadside sellers, street vendors, and supermarkets was approached for the study. This technique reduced selection bias and ensured a representative sample.

2.5.2 Secondary Data Collection

Secondary data were gathered from a number of sources, such as reputable websites like Department of Census and Statistics Sri Lanka, research articles, journals, and other publications. These data provided additional context and support to the analysis of primary data, improving the overall reliability of the study.

2.6 Data Analysis Methods

Data analysis was performed using IBM SPSS Statistics version 25. To analyze the collected data, descriptive statistics including percentage, frequency distribution, mean, mode, and median were used. To investigate the relationship between consumer preferences and demographic data, chi-square tests and cross tabulations were employed. Additionally, non-parametric tests, such as the Wilcoxon signed-rank test and the Friedman test, were employed to assess the significance of differences in preferences. This strategy ensured that customer preferences for mango qualities in the Monaragala district were thoroughly and robustly analyzed.

3. Result and Discussion

3.1 Introduction

Both inferential analysis and descriptive statistical methods were used to evaluate and interpret the data. In accordance with the objectives of the study, data analysis was done by using SPSS software. The research findings are presented in

this chapter with respect to the specified objectives. The study assesses the relative significance of quality, safety, and health factors in determining customer preference for mangoes under the first objective. The analysis highlights which attributes consumers prioritize most when selecting mangoes. For the second objective, the study aims to explore the correlation between customer preferences for quality, safety, and health features in mangoes and demographic factors. This include investigating how factors like age, gender, income, and education of the mango consumers affect purchasing behavior. According to the third objective, the study assesses consumer behavior in purchasing mangoes based on the quality, safety, and health attributes. This involves exploring purchasing patterns and preferences and how these attributes impact buying decisions. The study determines the post-harvest losses of mangoes at the consumer level under the fourth objective. The findings provide insights into the extent of post-harvest losses and the factors contributing to these losses, thereby offering potential strategies for reducing them.

3.2 Reliability of the study

Validity and reliability are two metrics used in quantitative research to measure the extent to which researchers have worked to improve the quality of their studies and findings. (Lobiondo and Haber, 2013). In quantitative studies, validity refers how a concept is measured with accuracy. Conversely, the accuracy and consistency of a research instrument is related to its reliability. It indicates the extent to which the instrument produces consistent results when used repeatedly under the same conditions. It is essential to evaluate the validity and reliability of data collection instruments when performing or reviewing research. Validity ensures that the instrument measures precisely what it is supposed to measure, and reliability ensures that the instrument consistently produce the same results when used repeatedly under identical circumstances.

The internal consistency of a research instrument is tested by using Cronbach's α . It calculates the mean of all correlations between the split halves of the instrument. This test can also be performed on instruments that have multiple response options. A Cronbach's α score falls between 0 and 1, with a score of 0.7 and above typically regarded as reliable. (Heale and Twycross, 2015).

Table 4.2: Reliability Test

Cronbach's Alpha	Number of items	Significance value
0.810	54	0.000

Source: Based analytical results of SPSS

For this instrument (questionnaire), Chronbach's Alpha was 0.810 with the significance of $p < 0.005$. So the external consistency was good and the research tool was reliable and will give credible results.

3.3 Socio demographic information of the respondents

A description of the sample socio demographics is provided in Table 4.2. The demographic analysis of the respondents shows that middle-aged and older adults make up the majority of these consumers, with 61.2% of the total respondents falling within the 41–60 age range. Furthermore, the percentage of male customers (60.2%) is larger than that of female consumers (39.8%), indicating that gender-based preferences or participating in purchasing. The respondents had quite high levels of education; more over half (55.1%) have finished their Tertiary education (Grades 11–12). 52.6 percent of the respondents work for themselves, which indicates that a significant portion of the population engaged in their own business or is involved in farming. Families with four to six individuals make up the majority of responses (75.5%), which is typical for the area. The average household size in Monaragala was 3.6, based on the data from Department of Census and Statistics, 2019. When considering how the choice of shop types varies with the demographics of the respondents, young consumers in age below 30 years favoring supermarkets, older age groups (41-50 and 51-60 years) and large families who have 4-6 and 7-9 members in their family trend more towards retail and wholesale shops. Males have stronger overall purchasing frequency across all shop types, but especially across retail and wholesale shops. Additionally, education and income levels further differentiate preferences, with higher-educated and higher-income groups showing a balanced preference across shop types probably due to better awareness of product quality and having access to higher incomes. In Monaragala district mean income in 2019 was Rs. 32,879 for its residents (Department of Census and Statistics, 2019). In contrast, the majority (53.1%) are classified as middle-income earners since their monthly income falls between Rs. 25,000 and Rs. 50,000. Individuals with monthly income of less than Rs. 25,000, tend to buy more frequently from street vendors and wholesale shops. The reasons could be lower prices compared to the other options. On the other extreme, people receiving a monthly income between Rs. 100,000 to 200,000 prefer supermarkets. Probably, they would go for supermarkets because of convenience and variety.

In terms of lifestyle and sociodemographic factors, demonstrate that engagement in sports and gender have a significant impact on mango consumption (Spina *et al*, 2023). Customers typically look for more desirable features, which may be divided into two categories: experience attributes (taste, juiciness, pulp texture) and search attributes (size, color, peel thickness) consequently, these preferences can lead to increased market demand from repeat purchases by satisfied consumers. (Manila *et al.*, 2020). The social component impacting purchase decisions turned out to be family. Family impact may result from members' inclination to talk about food choices and their concern for one another's health (Chauke and Duh, 2019).

Table 4.3: Demographic profile of the respondents participated for the survey

Demographics	Category	Frequency	Total	Percentage (%)			
				Super market	Retail shops	Street vendors	Wholesale shops
Age (in years)	<30	8	4.1	1.1	0.5	1.1	1.5
	31-40	42	21.4	2.6	9.7	4.1	5.1
	41-50	58	29.6	4.1	8.2	7.7	9.7
	51-60	62	31.6	5.1	6.1	7.7	12.8
	>60	26	13.3	2.6	6.1	2.6	2.0
Gender	Male	118	60.2	8.2	19.4	14.3	18.4
	Female	78	39.8	7.1	11.2	8.7	12.8
Education level	Secondary (Grade 6-10)	10	5.1	0	0.5	2.1	2.6
	Tertiary (Grade 11-12)	108	55.1	9.2	20.9	11.2	13.8
	Vocational/ technical	69	35.2	4.6	8.2	9.7	12.8
	Graduate	9	4.6	1.5	1.1	0	2.1
Employment (Job)	Government Employees	26	13.3	3.1	5.6	2.1	2.6
	Company Employees	65	33.2	7.7	9.7	8.1	7.7
	Self-Employed	103	52.6	4.6	14.8	12.8	20.4
	Others (e.g. part-time)	2	1.0	0	0.5	0	0.5
Monthly income	<Rs. 25,000	45	23.0	3.6	6.1	9.2	4.1
	Rs. 25,000-50,000	104	53.1	6.6	16.8	5.6	24
	Rs. 50,000 – 100,000	43	21.9	4.1	7.1	8.1	2.6
	Rs. 100,000- 200,000	4	2.0	1.1	0.5	0	0.5
Family size	<4	45	23.0	4.1	5.6	10.7	2.6
	4-6	148	75.5	11.2	24	12.2	28.1
	7-9	3	1.5	0	1.1	0	0.5

Source: Survey data 2024

3.4 The relative importance of quality, safety, and health attributes in influencing consumer preference for mangoes.

3.4.1 Result of Friedman test

When it comes to where respondents in the Monaragala area prefer to buy mangos, retail stores and street vendors/roadside sellers are strongly preferred by the respondents (Table 4.3). However, purchasing directly from wholesale marketplaces, supermarkets, and mango growers is less preferred. Roadside vendors and retail stores are more easily accessible for daily purchases because they are often located near residential areas. Price-conscious customers are drawn to them because they offer more competitive pricing than supermarkets and because street sellers often allow for bargaining, which gives customers the impression that they are receiving a better deal. However, supermarkets may not

be in a convenient location for many customers, resulting in longer travel times, and they frequently have greater overhead costs, which drives up the price of mangoes. The majority of mango farms are located outside of cities, which makes them less accessible for daily, casual purchases. Additionally, farmers may prefer to sell in large quantities, which may not be suitable for individual customers who prefer smaller amounts. Direct purchases from farmers are also limited to certain seasons when mangoes are harvested, reducing the year-round availability that retail shops or street vendors can offer through their supply chains. Wholesale markets generally cater to larger buyers such as retailers or businesses, not individual consumers, making the bulk quantities sold at these markets impractical for everyday consumers.

Table 4.4: Mango purchasing locations

	Mean rank
From mango farmers	1.99
Wholesale market	2.14
Retail shops	4.28
Roadside sellers/ street vendors	4.44
Supermarket	2.15

Source: Survey data 2024

The Friedman test was used to see how different mango flavors were preferred by the respondents (Table 4.4). Based on this, the most popular flavor among respondents is the sweet mango flavor.

Table 4.5: Sweetness of mango preferred by the consumers

	Mean rank
Sweet	3.27
Tangy	2.35
Balanced (sweet and tangy)	2.90
No preference	1.48

Source: Survey data 2024

3.4.2 Results of One sample Wilcoxon signed rank test

For each of the significant factors, concerning consumers about quality, safety, and health attributes of mangoes as well, one-sample Wilcoxon signed-rank tests were applied. All the null hypotheses that these factors do not significantly affect consumer concerns about them were rejected ($p < 0.05$).

As shown in Table 4.5, all the factors that were evaluated display statistical significance in Wilcoxon Signed Rank Test; this implies the null hypothesis is rejected. From the test values, customers tend to rate health and safety as their topmost concerns. They look out for fresh fruits with no

insect attack or diseases and which have no traces of pesticides on them. These are among the internal quality attributes believed to be important components of the acceptability of fruits by consumers along with freshness,

firmness, and sweetness. Other external qualities like smooth texture without wrinkles and have strong, pleasant aroma are also critical parameters for a mango lover.

Table 4.6: Quality, safety and health attributes of mango that consumer concern when purchasing mango

Sub variable	Mean	Sig.	Test value	Decision
External quality attributes				
Uniformity of color was concern by consumers when purchasing mango	3.48	0.000	5.185	Color uniformity was concerned by consumers in buying mangoes.
Absence of damage (bruises, cuts, blemishes) was concern by consumers when purchasing mango	4.33	0.000	11.284	The absence of any damage (bruises, cuts, blemishes) was highly considered by consumers when buying mango.
Shape was concern by consumers when purchasing mango	2.76	0.001	- 3.418	Shape was concern by consumers when purchasing mango by consumers
Wrinkle-free texture was concern by consumers when purchasing mango	4.02	0.000	9.951	Wrinkle-free texture was an important consideration for the consumer in buying mangoes.
Strong and pleasant fruit aroma was concern by consumers when purchasing mango	4.06	0.000	10.031	Strong and pleasant fruit aroma, was considered by the consumers when buying mango.
Internal quality attributes				
A deep, intense flesh color was concern by consumers when purchasing mango	3.67	0.000	7.318	Deep, intensive flesh color was considered by the consumer in buying mangoes.
Firmness of the mango was concern by consumers when purchasing mango	3.86	0.000	9.430	Firmness of the mango was important for consumers when purchasing mango
The absence of any fibrous texture was concern by consumers when purchasing mango	3.50	0.000	5.749	The absence of any fibrous texture was concern by consumers when purchasing mango
Balance of sweetness and acidity in mango was concern by consumers when purchasing mango	3.95	0.000	9.654	Balance of sweetness and acidity in mango was important for consumers when purchasing mango
Freshness was concern by consumers when purchasing mango	4.28	0.000	10.866	Freshness was highly concerned by consumers when purchasing mango
The sweetness of mango was concern by consumers when purchasing mango	4.08	0.000	9.978	The sweetness of mango was concerned by consumers when purchasing mango
Health and safety attributes				
Free from visible signs of disease (e.g., mold, rot) was concern by consumers when purchasing mango	4.38	0.000	11.385	Free from visible signs of disease (e.g., mold, rot) was highly concern by consumers when purchasing mango
Free from insect damage (e.g., holes, insect droppings) was concern by consumers when purchasing mango	4.39	0.000	11.542	Free from insect damage (e.g., holes, insect droppings) was highly concern by consumers when purchasing mango
Free from mechanical damage (e.g., bruises, cuts) was concern by consumers when purchasing mango	4.38	0.000	11.354	Free from Mechanical damages (bruises, cuts) was a highly concerned of consumers when purchasing mango.
Clean and free from dirt or debris was concern by consumers when purchasing mango	4.40	0.000	11.627	Clean and free from dirt or debris was highly concern by consumers when purchasing mango
Pesticide residue-free (grown with minimal or no pesticides) was concern by consumers when purchasing mango	4.41	0.000	11.453	Pesticide residue-free (grown with minimal or no pesticides) was highly concern by consumers when purchasing mango

Significant at 0.05 (Source: Survey data 2024)

3.4.3 Descriptive statistics

As shown in Table 4.6, a majority of consumers preferred a balanced textured mango, with 110 respondents (56.1%). This is followed by 70 consumers (35.7%) who preferred a juicy and soft textured mango.

Table 4.7: Texture of the mango that consumers most preferred

Texture	Percentage %
Firm a crisp	6.1
Juicy and soft	34.7
Balanced texture	56.1
No preference	2.0

Source: Survey data 2024

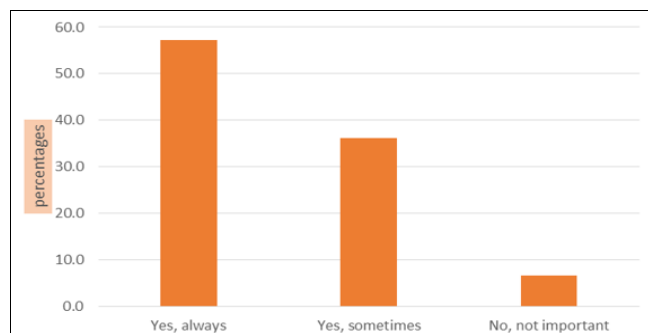
Table 4.7 shows that maximum number of consumers prefer ripe mangoes with 95 respondents, which accounts for 48.5%. It is followed by 80 consumers who liked moderately ripe mangoes, accounting for 40.8%.

Table 4.8: Ripeness level of mango that consumers most preferred

Ripeness level of mango	Percentage %
Very ripe	2.6
Ripe	48.5
Moderately ripe	40.8
Less ripe	6.6
Very less ripe	1.5

Source: Survey data 2024

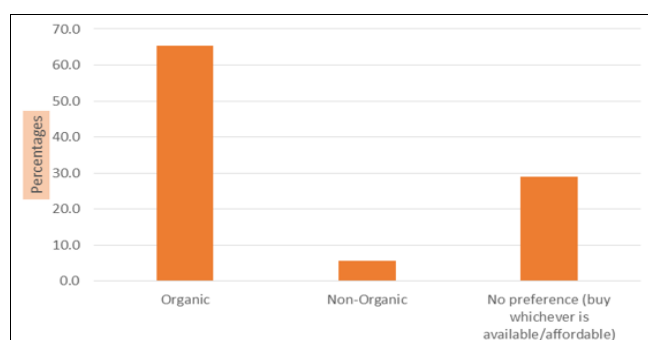
Significant majority is willing to pay for naturally ripened mangoes over artificially ripened mangoes always (Fig 4.1). People are ready to pay a premium for the naturally ripened mango over artificially ripened mangoes because they are free from harmful chemicals used in artificial ripening process and is healthier; and also they believe that natural ripening process of fruits preserves the nutritional value and overall quality. This relates to the health and safety attributes that consumers consider when buying mango.



Source: Survey data 2024

Fig 4.1: Willingness to pay for naturally ripened mangoes over artificially ripened ones

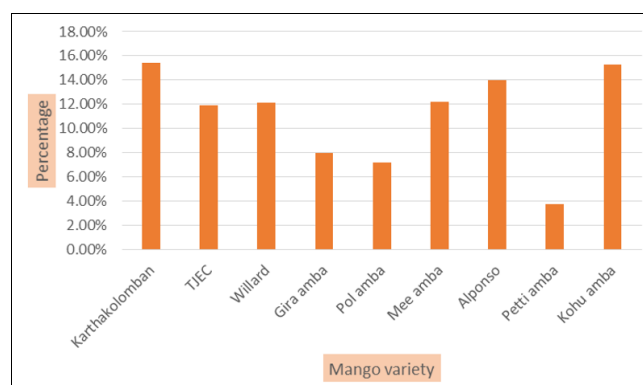
Organic food consumption is good for consumer well-being and the environment. Although Export Promotion of Organic Products from Africa believes that food from organic production is expensive as opposed to conventional food produced in emerging economies, it is still sought after for perceived health benefits and environmental sustainability (Asif *et al.*, 2018). Results of this study shows that significant majority of respondents (65.3%), preferred organic mangoes over non organic mangoes (Fig 4.2). Now, the production and consumption of organic food may not only be in favor of the environment and consumers; it may also provide marketers with a competitive advantage and higher profits as consumers in these markets are ready to pay higher prices and advocate for organic products (Chauke and Duh, 2019). Mango origin is another important consideration while making a purchase. Product origin and environmental factors play a major role in customer decision-making (McEachern and Warnaby., 2004).



Source: Survey data 2024

Fig 4.2: Preference for organic grown or non-organic grown mango

The data clearly shows the diversity in preferences for different varieties of mangoes (Fig 4.3); Karthakolomban (15.4%), Kohu amba (15.3%) and Alfonso (14.0%) varieties are highly preferred by consumers having higher percentages of consumption among respondents.



Source: Survey data 2024

Fig 4.3: Mango varieties that respondents generally consume

3.5 The relationship between demographics and consumer preferences for quality, safety, and health attributes in mangoes

This cross-tabulation of the attributes related to the quality, safety, and health of the mangoes with the demographic information would hence show how these preferences vary across different demographic sectors in Monaragala District.

3.5.1 External Quality Attributes:

According to Table 4.8, when the demographic information is cross tabulated with the external quality attributes of mango, it results in a statistically significant relationships among Age of the respondents and preference for mango shape, level of education of the respondents and preference for mangoes with no damage, occupation of the respondents and preference for mango shape. The rest of the relationships were all not significant from the provided p-values where $p > 0.05$.

The Table 4.8 shows some significant relationships such as, Education level has a significant relationship with the preference for damage free mangoes. ($\chi^2 = 23.441$, $p = 0.005$), Age of the consumers has a significant relationship with the consumer preference for shape of the mangoes. ($\chi^2 = 32.612$, $p = 0.008$) and Occupation of the consumers has a significant relationship with the preference for the shape of the mangoes ($\chi^2 = 21.313$, $p = 0.046$).

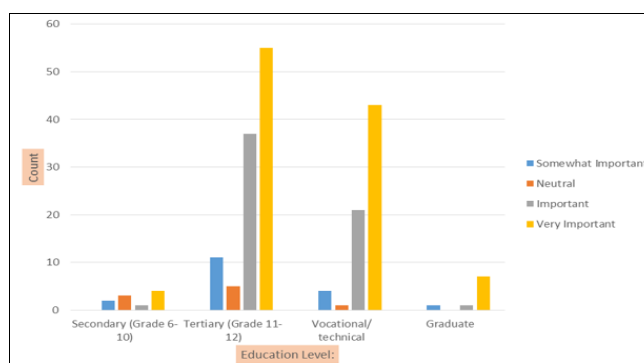
Table 4.9: Cross tabulation of External quality attributes of mango and Demographic information

	Uniformity of color		Absence of damage (bruises, cuts, blemishes)		Shape		Wrinkle-free texture		Strong and pleasant fruit aroma	
	Chi -square value	Sig. (2 sides)	Chi -square value	Sig. (2 sides)	Chi -square value	Sig. (2 sides)	Chi -square value	Sig. (2 sides)	Chi -square value	Sig. (2 sides)
Age	17.092 ^a	0.380	5.557 ^a	0.937	32.612 ^a	0.008	20.970 ^a	0.180	19.855 ^a	0.227
Gender	7.540 ^a	0.110	4.199 ^a	0.241	6.192 ^a	0.185	4.066 ^a	0.397	1.305 ^a	0.861
Education level	10.086 ^a	0.608	23.441 ^a	0.005	12.510 ^a	0.406	10.912 ^a	0.536	7.642 ^a	0.812
Occupation	14.357 ^a	0.278	13.500 ^a	0.141	21.313 ^a	0.046	7.241 ^a	0.841	13.652 ^a	0.324
Monthly income	17.546 ^a	0.130	13.776 ^a	0.131	14.906 ^a	0.247	11.329 ^a	0.501	17.896 ^a	0.119
Family size	11.298 ^a	0.185	1.048 ^a	0.984	8.214 ^a	0.413	3.598 ^a	0.891	12.299 ^a	0.138

a- Not assuming the null hypothesis (Source: Survey data 2024)

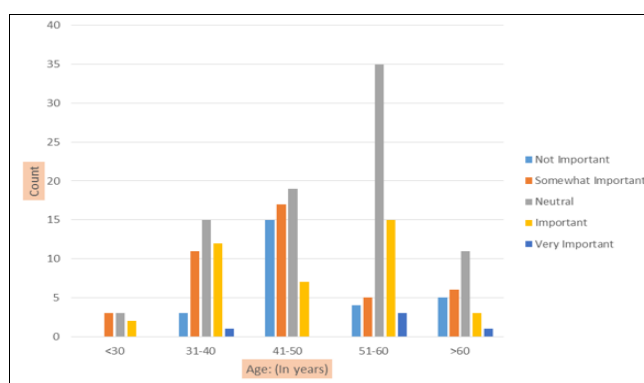
The figures 4.4, 4.5 and 4.6 indicate that, older age groups, particularly those aged 51-60 and above, tend to place greater importance on the shape of the mango, while the younger groups tend to be more neutral. Respondents that have tertiary level education and respondents with vocational/technical training place more importance on a

damage-free mango, indicating that absence of bruises or blemishes is important. Besides, occupation also affects preference: government employees are more likely to prioritize the shape of mangoes compared to company employees and self-employed people, who have a diverse level of opinions.



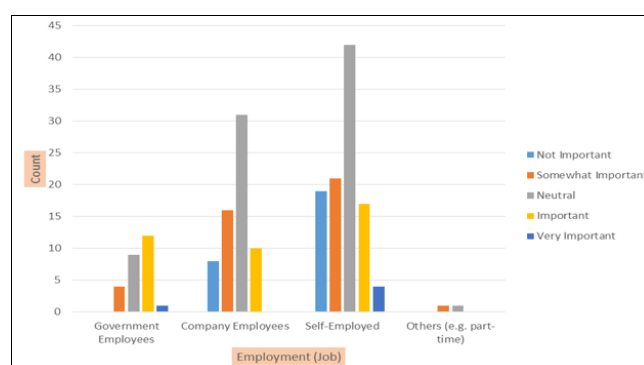
Source: Survey data 2024

Fig 4.4: Relationship between Education level and the preference for damage free mangoes



Source: Survey data 2024

Fig 4.5: Relationship between Age of the consumers and the shape of the mangoes



Source: Survey data 2024

Fig 4.6: Relationship between occupation of the consumers and the shape of the mangoes

3.5.2 Internal Quality Attributes:

Knowing what criteria consumers use to evaluate food choices can really help in understanding market dynamics. The importance of the different food values differed among the mango consumers, with taste being most influential in most cases. According to Kiesel and Boas, 2013, there is a strong relationship between taste and nutritional qualities, specifying that perceptions of health and nutritional excellence might drive important variations in one's taste experience. Consumers purchase mangoes basically for their intrinsic qualities like taste and nutritional content, very

close to the ideas of health and well-being. Among the modern consumer, intrinsic qualities hold high value (Spina *et al.*, 2023).

According to Table 4.9, when the cross tabulation is done among the demographic information and internal quality attributes of mango, there are statistically significant relationships between:

The preference for the freshness of mangoes with age of the respondents, education level of the respondents and preference for mangoes that have deep, intense flesh color, education level of the respondents and preference for

firmness of mangoes, and family size and preference for deep, intense flesh color in mangoes. All the other relationships, according to these p-values provided, were not significant in nature, since $p > 0.05$ in these cases.

According to the Table 4.9, there are some significant relationships such as, Education levels of the consumers has a significant relationship with the preference for the flesh

color of mangoes. ($\chi^2 = 23.296$, $p = 0.025$), Education levels of the consumers has a significant relationship with the consumer preference for firmness of mangoes. ($\chi^2 = 23.637$, $p = 0.023$), Family size impacts the preference for intense flesh color of mango. - ($\chi^2 = 16.897$, $p = 0.031$) and Age of the respondents is significantly related to the preference for freshness of mangoes. - ($\chi^2 = 29.293$, $p = 0.022$).

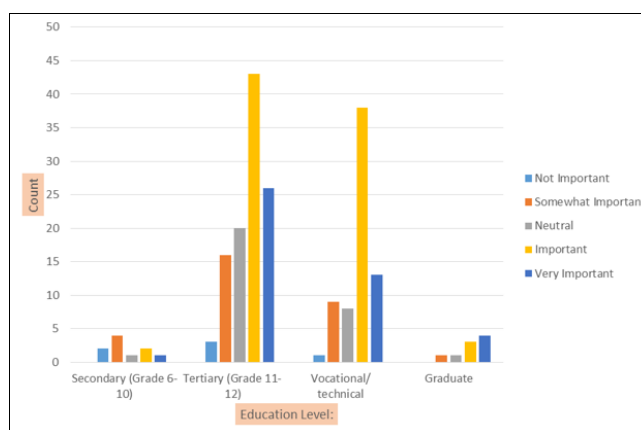
Table 4.10: Cross tabulation of Internal quality attributes of mango and Demographic information

	A deep, intense flesh color		Firmness of the mango		The absence of any fibrous texture		Balance of sweetness and acidity in mango		Freshness		The sweetness of mango	
	Chi -square value	Sig. (2 sides)	Chi -square value	Sig. (2 sides)	Chi -square value	Sig. (2 sides)	Chi -square value	Sig. (2 sides)	Chi -square value	Sig. (2 sides)	Chi -square value	Sig. (2 sides)
Age	24.604 ^a	0.077	10.697 ^a	0.828	11.525 ^a	0.776	13.325 ^a	0.649	29.293 ^a	0.022	17.115 ^a	0.378
Gender	2.436 ^a	0.656	4.451 ^a	0.348	2.919 ^a	0.571	7.515 ^a	0.111	5.740 ^a	0.219	2.404 ^a	0.662
Education level	23.296 ^a	0.025	23.637 ^a	0.023	12.232 ^a	0.427	17.116 ^a	0.145	11.143 ^a	0.517	15.255 ^a	0.228
Occupation	11.511 ^a	0.486	12.766 ^a	0.386	8.901 ^a	0.711	12.217 ^a	0.428	8.184 ^a	0.771	5.652 ^a	0.933
Monthly income	13.874 ^a	0.309	11.204 ^a	0.512	9.008 ^a	0.702	13.606 ^a	0.327	13.161 ^a	0.357	13.152 ^a	0.358
Family size	16.867 ^a	0.031	8.554 ^a	0.381	4.655 ^a	0.794	2.152 ^a	0.976	5.881 ^a	0.661	4.579 ^a	0.801

a- Not assuming the null hypothesis (Source: Survey data 2024)

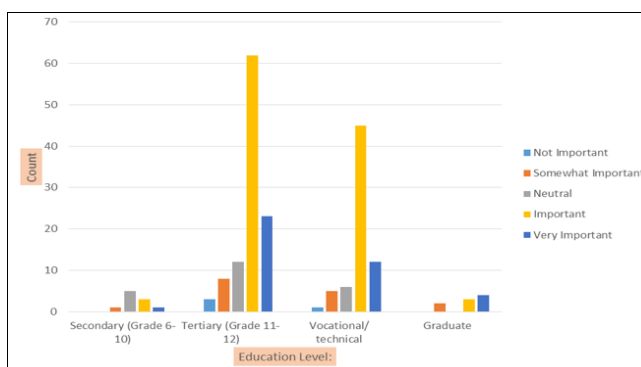
Figures below (Fig 4.7, Fig 4.8, Fig 4.9 and Fig 4.10) indicate that Age appears to impact the importance placed on mango freshness, respondents those within the 50-60-year group, give high importance to freshness of mango. Education level has a similar effect on preferences; those

who have tertiary level education and vocational training, show higher preference for the preference for flesh firmness and flesh color of mango. Additionally, respondents those with 4-6 members in their family, tends to place more importance on the deep intense flesh color of the mangoes.



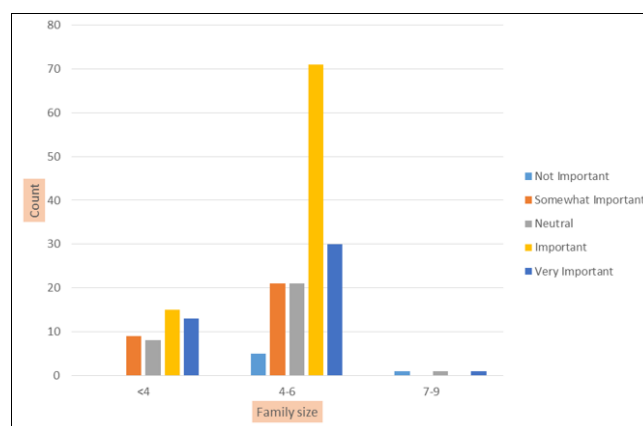
Source: Survey data 2024

Fig 4.7: Relationship between education levels of the consumers and the preference for the flesh color of the mangoes



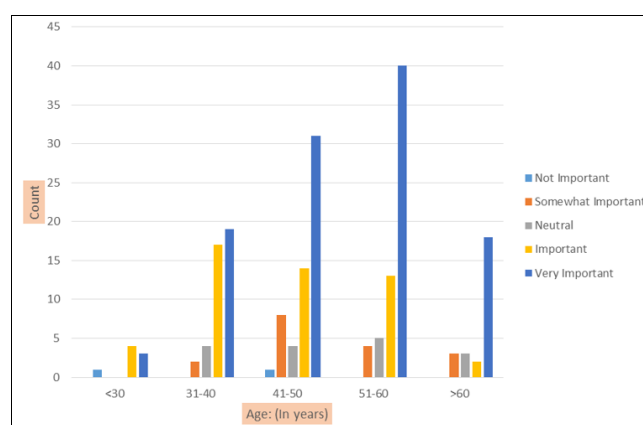
Source: Survey data 2024

Fig 4.8: Relationship between education levels of the consumers and the preference for the firmness of the mangoes



Source: Survey data 2024

Fig 4.9: Relationship between family size of the consumers and the preference for intense flesh color of the mangoes



Source: Survey data 2024

Fig 4.10: Relationship between age of the consumers and the preference for freshness of the mangoes

3.5.3 Health and Safety Attributes:

While purchasing mangoes, the price factor might not be strongly emphasized by consumers because the fruit is perceived to have an intrinsic value of being a promoter of well-being. In addition, due to greater health issues, the consumer is more concerned and consumes mangoes more frequently. Consumers choose mangoes for reasons directly or indirectly related to the perception of health or nutritional value (Spina *et al.*, 2023).

According to Table 4.10, when the cross tabulation is done among the demographic information and health and safety attributes of mango there are statistically significant relationships between: Age of the respondent and the preference for mangoes that are free from visible signs of disease, for example, mold, rot; family size and the

preference for mangoes that are free from visible signs of disease, for example, mold, rot; family size and the preference for mangoes that are free from mechanical damage, for example, bruises, cuts. For the remaining relationships, there were no statistical significances using the p-values provided with $p > 0.05$.

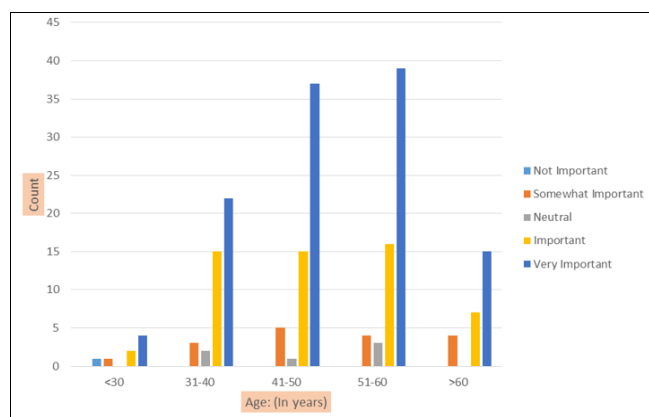
The Table 4.10 shows that there are some significant relationships such as, Age influences the perception of mangoes being free from visible signs of disease. - ($\chi^2 = 29.293$, $p = 0.019$), Family size is significantly related to the preference for mangoes free from absence of mechanical damages ($\chi^2 = 22.647$, $p = 0.004$) and Family size is significantly related to the preference for mangoes being free from visible signs of disease ($\chi^2 = 67.233$, $p = 0.000$).

Table 4.11: Cross tabulation of Health and safety attributes of mango and Demographic information

	Free from visible signs of disease (e.g., mold, rot)		Free from insect damage (e.g., holes, insect droppings)		Free from mechanical damage (e.g., bruises, cuts)		Clean and free from dirt or debris		Pesticide residue-free (grown with minimal or no pesticides)	
	Chi -square value	Sig. (2 sides)	Chi -square value	Sig. (2 sides)	Chi -square value	Sig. (2 sides)	Chi -square value	Sig. (2 sides)	Chi -square value	Sig. (2 sides)
Age	29.785 ^a	0.019	9.325 ^a	0.675	14.846 ^a	0.536	15.483 ^a	0.216	9.128 ^a	0.908
Gender	2.490 ^a	0.646	2.860 ^a	0.414	4.066 ^a	0.397	2.013 ^a	0.570	2.629 ^a	0.622
Education level	5.919 ^a	0.920	4.376 ^a	0.885	7.407 ^a	0.830	3.614 ^a	0.435	14.734 ^a	0.256
Occupation	7.654 ^a	0.812	5.804 ^a	0.759	19.912 ^a	0.069	9.602 ^a	0.384	17.406 ^a	0.135
Monthly income	12.591 ^a	0.399	4.347 ^a	0.887	11.142 ^a	0.517	4.742 ^a	0.856	8.817 ^a	0.718
Family size	67.233 ^a	0.000	7.518 ^a	0.276	22.647 ^a	0.004	11.059 ^a	0.087	6.966 ^a	0.540

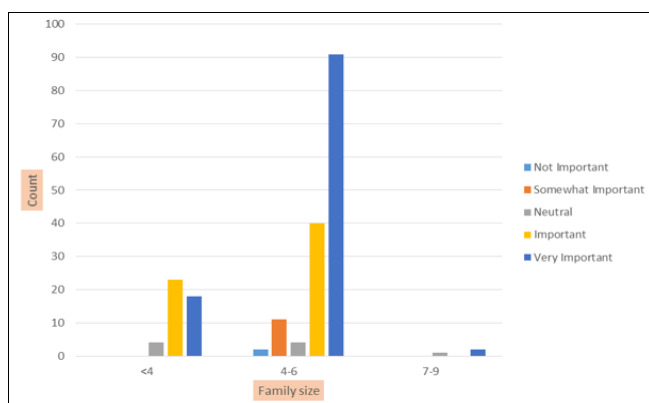
a- Not assuming the null hypothesis (Source: Survey data 2024)

Figures below (Fig 4.11, Fig 4.12 and Fig 4.13) indicate that demographic factors such as age and family size significantly influence consumer preference for disease-free and mechanically undamaged mangoes. Among the age categories of respondents, 41-60 years and above, place a high priority on mangoes being free from visible signs of disease, while younger consumers below 30 years have quite diverse opinions. Respondents that have 4-6 members and 7-9 members in their families prioritize disease-free mangoes and mechanically undamaged mangoes. Additionally, smaller families show a more diverse range of preferences, with some placing less emphasis on these quality aspects.



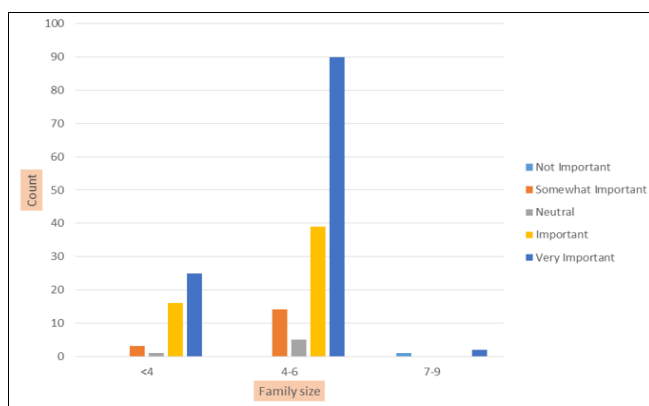
Source: Survey data 2024

Fig 4.11: Relationship between age of the consumers and the perception of mangoes being free from visible signs of disease



Source: Survey data 2024

Fig 4.12: Relationship between family size of the consumers and the preference for mangoes free from mechanical damages



Source: Survey data 2024

Fig 4.13: Relationship between family size of the consumers and the perception of mangoes being free from visible signs of disease

3.6 Consumer behavior on purchasing the mangoes according to the quality, safety, and health attributes of mango

3.6.1 Results of Pearson correlation test

Previous studies conducted on the food environment and health status emphasize the need for identification of the drivers for dietary behaviors and food security, including food purchasing behavior. These purchasing behaviors are influenced by food accessibility and availability at the local community and neighborhood levels (Bottcher *et al.*, 2019). According to Chauke and Duh, (2019), the product attributes significantly influenced purchasing decisions. The psychological factors of behavioral beliefs and perceived value in their relations to overall image, and the social factors of family influences, were drivers of purchase behavior.

There is no significant correlation between the frequency of buying mangoes and quality, safety, and health attributes. There is a positive correlation between preference to wrinkle-free Texture Mangoes and quantity bought at one time with $r = 0.161$, $p < 0.05$, which shows consumers inclined to purchase more frequently place a greater value on preference for wrinkle-free textured mango. That is, in this group, maintaining the external quality is pretty imperative.

There is a negative correlation between preference for uniformity of color in mangoes and quantity purchased at a time ($r = -0.192$, $p < 0.01$), which suggests that consumers who buy a big amount tend to have a low concern in mango color uniformity. The negative correlation may suggest that bulk buyers may not concern color variations as much, probably for price reasons or expectation of bulk discounts. Those who buy more concern less about the uniformity of color of mangoes; they will concern about wrinkle-free textured mango, and generally no significant correlations with other quality attributes.

There was a significant negative correlation between the willingness to pay more for naturally ripened mangoes and the preference for undamaged mangoes ($r = -0.181$, $p < 0.05$); in other words, those who were willing to pay more for naturally ripen mangoes had a negative attitude towards the absence of damages on the mango.

An inverse correlation exists between preference for mangoes with deep intense flesh color and willingness to pay more for naturally ripened mangoes; it is significant at $p < 0.05$, with $r = -0.141$, an indication that the flesh color is valued less by those willing to pay a higher price for naturally ripened mangoes.

There is a negative correlation between preference for mangoes that are free from visible signs of diseases and the Willingness to Pay More for Naturally Ripened Mangoes ($r = -0.197$, $p < 0.01$), indicating those who are willing to pay more for naturally ripened mangoes place less importance on the mangoes being free from visible signs of disease.

Preference for mangoes that are free from insect damages presents a negative correlation with Willingness to Pay More for Naturally Ripened Mangoes ($r = -0.183$, $p < 0.05$) and with mangoes that are free from mechanical damages ($r = -0.163$, $p < 0.05$), meaning that those willing to pay more for naturally ripened mangoes have less concern in mangoes free from insect and mechanical damages. Negative correlations suggest that consumers who prioritize natural ripening are less concerned with flesh color and minor damages, possibly viewing natural ripening as a sign of

overall quality.

.Generally, no significant correlations with external, internal quality attributes or health and safety attributes and Willingness to Pay a Premium for Organic or Pesticide-Free Mangoes.

There is a positive correlation between preference for uniform coloration of the mangoes and willingness to pay a

premium to minimize postharvest losses ($r = 0.212$, $p < 0.01$), implicating value to a reduction in postharvest losses among those paying for it. Specifically, positive correlation indicates a preference for uniform mangoes among people who are ready to invest in reducing postharvest losses, while for others, there is no such preference.

Table 4.12: Results of Pearson correlation test

	Frequency of purchase mangoes		Purchase quantity (number) at a time		Willingness to pay more for naturally ripened mangoes over artificially ripened ones		Willingness to pay a premium for mangoes that are labeled as organic or pesticide-free		Willingness to pay a slight premium for mangoes if it helped reduce post-harvest losses		Purchasing locations	
	Pearson correlation	Sig. (2 tailed)	Pearson correlation	Sig. (2 tailed)	Pearson correlation	Sig. (2 tailed)	Pearson correlation	Sig. (2 tailed)	Pearson correlation	Sig. (2 tailed)	Pearson correlation	Sig. (2 tailed)
Uniformity of color	-0.070	0.326	-.192**	0.007	-0.117	0.102	0.099	0.167	.212**	0.003	-0.046	0.518
Absence of damage (bruises, cuts, blemishes)	0.032	0.659	0.009	0.901	-.181*	0.011	0.027	0.712	0.004	0.953	-0.088	0.220
Shape	-0.001	0.988	-0.060	0.407	0.069	0.335	-0.059	0.409	0.064	0.374	-0.098	0.171
Wrinkle-free texture	0.061	0.398	.161*	0.024	-0.087	0.224	-0.048	0.507	0.080	0.267	-0.130	0.069
Strong and pleasant fruit aroma	0.031	0.670	0.110	0.123	-0.085	0.235	0.002	0.972	0.048	0.500	0.045	0.534
A deep, intense flesh color	0.011	0.878	0.032	0.659	-.141*	0.049	-0.004	0.957	0.052	0.471	-0.008	0.910
Firmness of the mango	0.030	0.680	0.040	0.573	-0.065	0.366	0.067	0.353	0.085	0.236	-0.113	0.113
The absence of any fibrous texture	0.061	0.397	0.082	0.255	0.056	0.433	0.052	0.470	0.041	0.565	0.073	0.310
Balance of sweetness and acidity in mango	0.047	0.511	0.046	0.524	-0.046	0.522	-0.060	0.402	0.121	0.090	-0.078	0.276
Freshness	-0.013	0.861	0.060	0.405	-0.027	0.709	-0.118	0.101	-0.078	0.279	-0.125	0.080
The sweetness of mango	-0.030	0.680	-0.024	0.741	-0.027	0.709	-0.062	0.389	0.028	0.697	-0.039	0.583
Free from visible signs of disease (e.g., mold, rot)	0.098	0.172	0.065	0.364	-.197**	0.006	-0.092	0.199	0.058	0.421	-0.017	0.808
Free from insect damage (e.g., holes, insect droppings)	0.127	0.076	0.080	0.263	-.183*	0.010	-0.032	0.657	0.016	0.822	0.013	0.861
Free from mechanical damage (e.g., bruises, cuts)	0.089	0.217	0.102	0.155	-.163*	0.023	0.078	0.279	0.060	0.401	0.045	0.527
Clean and free from dirt or debris	0.115	0.108	0.085	0.237	-.197**	0.006	0.132	0.066	0.036	0.616	-0.019	0.787
Pesticide residue-free (grown with minimal or no pesticides)	0.067	0.347	-0.023	0.745	-.174*	0.015	0.040	0.578	0.076	0.292	-0.129	0.072
Mangoes that are guaranteed to be chemical-free	-0.047	0.517	-0.113	0.114	-.157*	0.028	0.054	0.454	0.075	0.297	-.149*	0.037
Preference for organic or non-organic mango	-0.092	0.201	-0.047	0.515	0.126	0.079	-0.114	0.111	-0.106	0.140	0.090	0.209
Ripe or less ripe mangoes	0.076	0.292	-0.080	0.268	0.035	0.629	-0.037	0.611	0.099	0.169	-0.088	0.219
Origin and traceability of the mango	-0.041	0.565	0.049	0.491	-0.051	0.479	0.076	0.287	-0.018	0.804	-0.013	0.859
Texture	0.121	0.091	-0.010	0.890	0.036	0.620	-0.115	0.110	-0.018	0.801	0.021	0.774
Green or reddish hue	-0.022	0.765	0.098	0.170	0.077	0.281	-0.081	0.261	0.004	0.953	-0.004	0.956

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed).

(Source: Survey data 2024)

3.7 Post-harvest losses of Mango at the consumer level

Post-harvest loss refers to both measurable quantitative and qualitative food losses in the post-harvest system. It incorporates a decrease in food quality or amount between harvest and the point of final consumption or processing. (Kiaya, 2014). Food losses occur at harvest, packing, transportation, at wholesale, retail markets and consumption if not well handled. Further losses can occur due to delays at customs, offloading, or breakdowns of transport vehicles. These show that extending the life of fruits will avert further losses. According to Msogoya and Kimaro, (2011) post-harvest losses are a challenge in both developing and developed countries within the horticultural production chain. Gebre-Mariam, (1999) has reported lack of postharvest and marketing infrastructure for packaging, cold storage, treatment, and washing as a major cause of postharvest fruit loss. That study showed major post-harvest losses attributed mainly due to mechanical damage such as bruising from mishandling and infestations. In general, post-harvest damage is influenced by factors like cultivar of the fruit, storage temperature, water content, specific gravity, and the degree of maturity of the fruit. Internal factors of fruit cell wall softening and the subsequent post-harvest deterioration include respiratory processes, ethylene production, enzymatic starch hydrolysis, and other carbohydrate hydrolyses. According to Baltazari *et al.* (2020), the post-harvest losses for mango have been reported at different levels of the supply chain, right from harvest, transport, wholesale, and retail levels, down to consumption levels. Such losses result from various factors, at different stages of post-harvest, comprising physical damage, insect attacks, or over-ripening and post-harvest diseases such as anthracnose.

Among the major factors that affect mango production are postharvest losses. One of the key contributions to postharvest losses in fresh mango fruits is that due to enzymatic degradation of carbohydrates and cell wall components as a result of softening (Lohani *et al.*, 2004.)

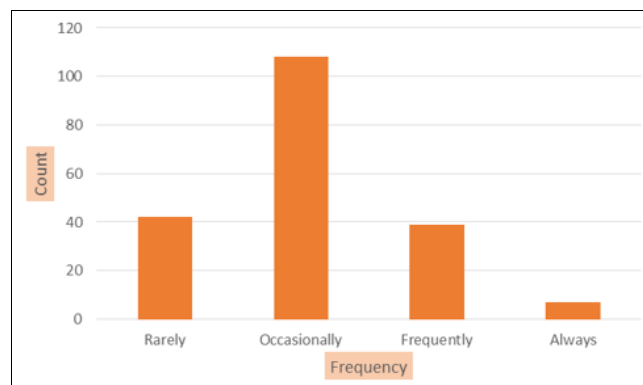
Results of Friedman test show that most of the respondents considered physical damage during handling to be the major cause of loss for the mangoes, with a mean rank of 4.28, followed by insect infestation with a mean rank of 3.84.

Table 4.13: Causes of mango losses

	Mean rank
Physical damage during handling	4.28
Improper storage conditions (temperature, humidity)	3.80
Fungal and bacterial diseases	3.42
Insect infestation	3.84
Lack of proper ripening techniques	3.58
Other	2.08

Source: Survey data 2024

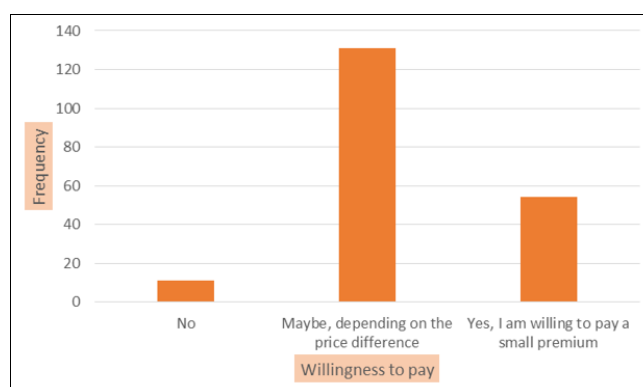
According to the results of the survey, Consumers occasionally throwing away mango due to over ripeness or spoilage before consuming them.



Source: Survey data 2024

Fig 4.14: Frequency of throwing away mangoes due to over ripeness or spoilage before consuming them

Consumers are willing to pay a slight premium for mangoes if it helps reduce post-harvest losses, mostly depending on the price difference. Although consumers are ready to pay a bit more for mangoes when they realize that doing so will help reduce post-harvest losses, this depends highly on how much more they are going to pay. In case of small and reasonable increases, since they are able to see less wastage and ensure better mango quality, they are for it. The willingness to pay more decreases in case of a high price difference.



Source: Survey data 2024

Fig 4.15: Willingness to pay slight premium for mangoes if it helped reduce post-harvest losses

4. Conclusion

This study investigated the connection between the production practices, safety and quality attributes, and customer preferences among the mango sector in Monaragala district in Sri Lanka. The results indicated that customers preferred health and safety factors such as the absence of pesticide residues, disease visibility, and mechanical damage over the appearance and sweetness. Moreover, freshness, firmness, and natural ripening also played a major role in buying decision.

Demographic information such as Age, Education, Occupation, and Household size strongly influenced

consumer attitudes. As an example, older and more educated consumers were more concerned about the cleanliness, firmness, and health factors of a product. Consumer behavior showed an increasing need for naturally ripened and organically grown mangoes, with most people willing to pay a higher price for such qualities because of the quality and health.

However, At the point of consumption consumer-level post-harvest losses continue to exist, with many cases of consumers reporting spoilage and over ripeness. These findings form the basis for the necessity of greater post-harvest care, better storage facilities, and greater consumer education to decrease the loss and increase the satisfaction. When the consumer needs are aligning with production, distribution, and marketing strategies, it can go a long way in improving the efficiency and sustainability of the mango value chain in Sri Lanka.

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